MULTI-MECHANICAL IN SITU TESTING FOR AUTOMOTIVE INDUSTRY DLC/INTERLAYER/M2-STEEL COATINGS

Sergio Sao-Joao, Mines Saint-Etienne, Univ Lyon, CNRS, UMR 5307 LGF, Centre SMS, France
sao-joao@emse.fr
Jihane Benmohamed, Antonios Choleridis, Guillaume Kermouche, Helmut Klocker, Mines Saint-Etienne, Univ Lyon, CNRS, France
Christophe Héau, Institut de Recherche en Ingénierie des Surfaces, HEF Groupe, France
Christophe Donnet, Laboratoire Hubert Curien, UMR 5516, Université Jean Monnet

Key Words: DLC, interlayer, In situ mechanical testing, micro-beam, micro-pillar

Wear resistance enhanced mechanical components with lower friction can help to answer to automotive industry challenges such as high performance, improved reliability and environmental friendly production. Diamond Like Carbon (DLC) deposited on mechanical components efficiently decrease the friction coefficient and insure wear protection [1]. DLC hard coatings, produced by Plasma Enhanced Chemical Vapor Deposition (PECVD), exhibit high compressive residual stress [2]. In order to improve coating adhesion, an appropriate interlayer is pre-deposited on mechanical components. However, in severe conditions, local coating delamination initiated by blistering is still occasionally detected [3]. To understand wear induced damage in DLC coated material and to optimize the coating/interlayer/substrate system design, very local and reliable mechanical data are required. The present work is dedicated to the investigation of mechanical properties of industrial DLC coatings. Several advanced experimental techniques were used to characterize DLC /interlayer/M2Steel samples.

Residual stress was investigated by the combination of FIB-machined micro-beams flexion analysis and finite elements modeling (cf.Fig.1). In situ nano-indentation and FIB-milled micro-pillar compression (cf. Fig.2) were also performed to determine some mechanical data that were then implemented in numerical model to simulate DLC damage. A specific attention was taken on the properties of both normal/transverse sides of the coatings.

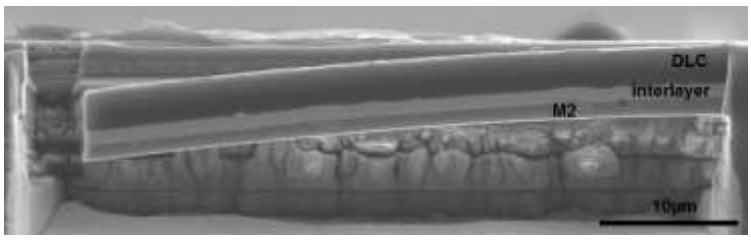

Figure1: DLC /interlayer/M2Steel mico-beam flexion observation

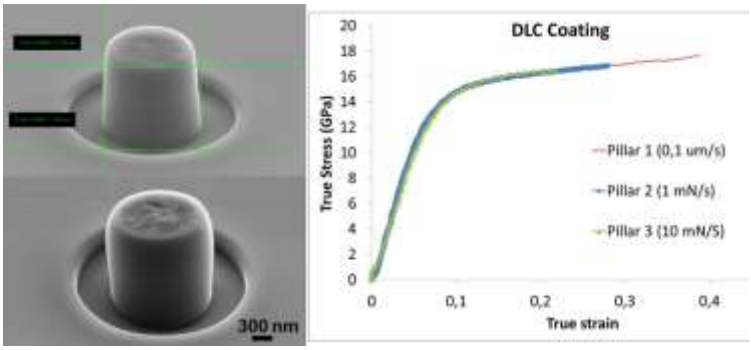

Figure2: DLC micro-pillar compression

[1] Christophe Donnet , Ali Erdemir Editors Tribology of Diamond-Like Carbon Films, Fundamentals and Applications, 2008, Springer, ISBN 978-0-3 G.G.
[2] T.W. Clyne (1996), Residual stresses in surface coatings and their effects on interfacial debonding, Key Eng. Mat. 116 (1996) 307-330.
[3] A. Choleridis, S. Sao-Joao, J.Ben-Mohamed, D.Chern, V. Barnier, G. Kermouche, Ch. Héau, M.-A. Leroy, J. Fontaine, S. Descartes, Ch. Donnet , H. Klöcker, Experimental study of wear-induced delamination for DLC coated automotive components, Surface & Coatings Technology 352 (2018) 549–560.